VTT Technical Research Centre of Finland

Building New Business Ecosystem Around Textile Recycling

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Contents

Sustainability

Overshooting global resources

Technologies and innovations

Markets

Know-how

New value networks

Why recycle textiles?

Circular economy transition

Recycling of textile waste

Building business ecosystem

telaketju

Textile waste

Regulation

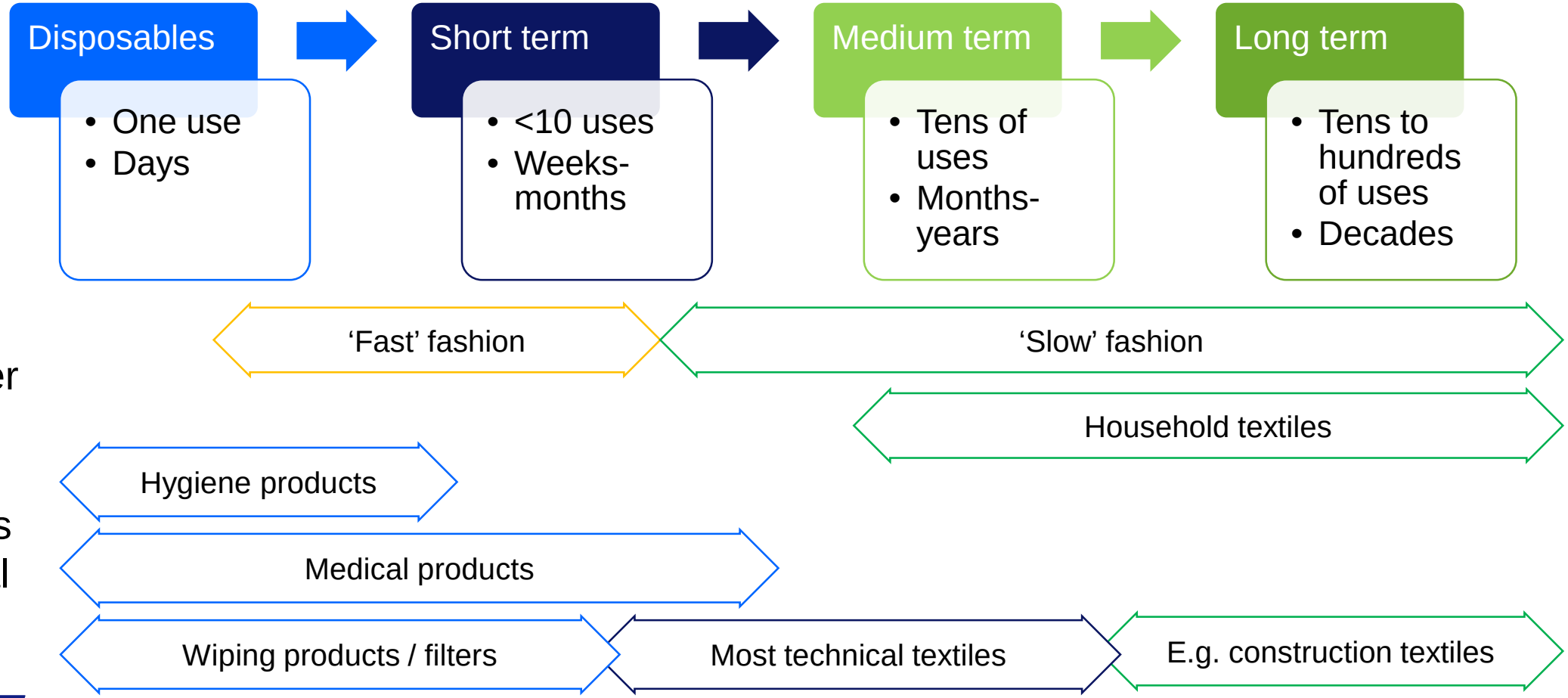
Consumers attitudes

Services

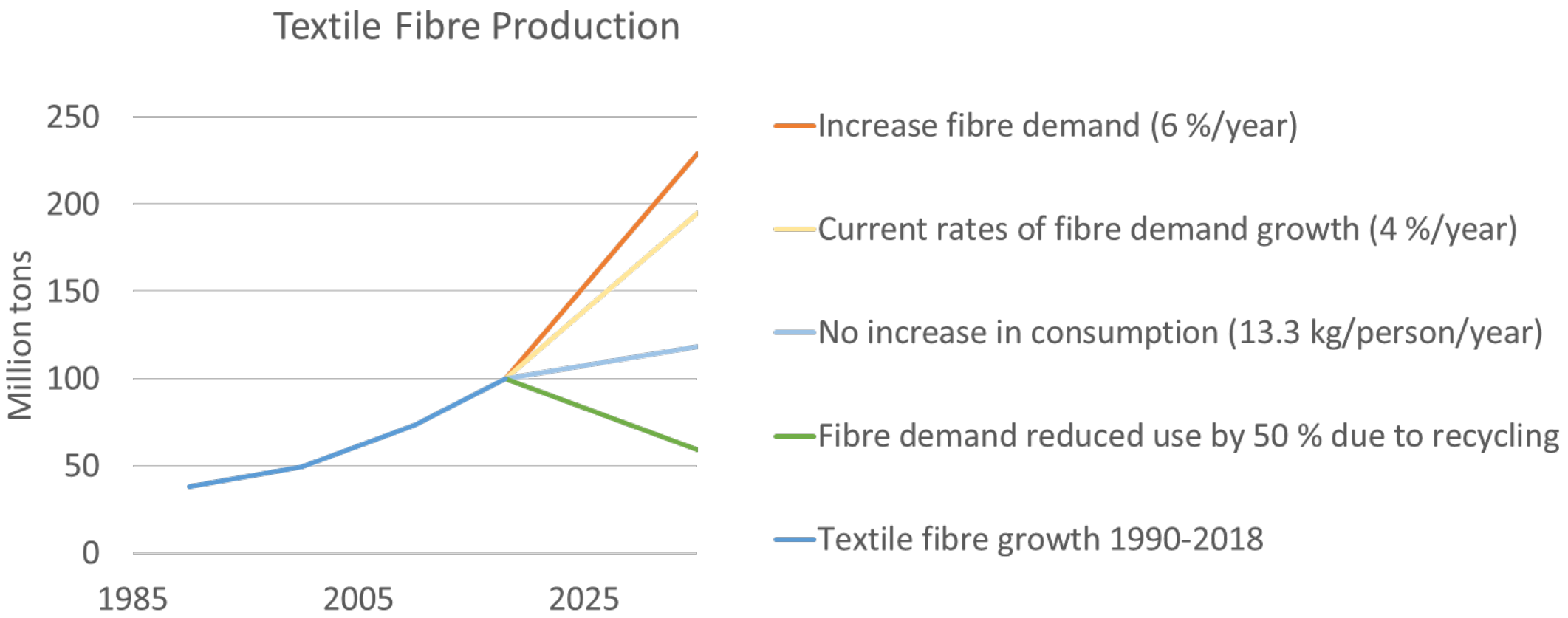
Digitalization

Tracking and tracing

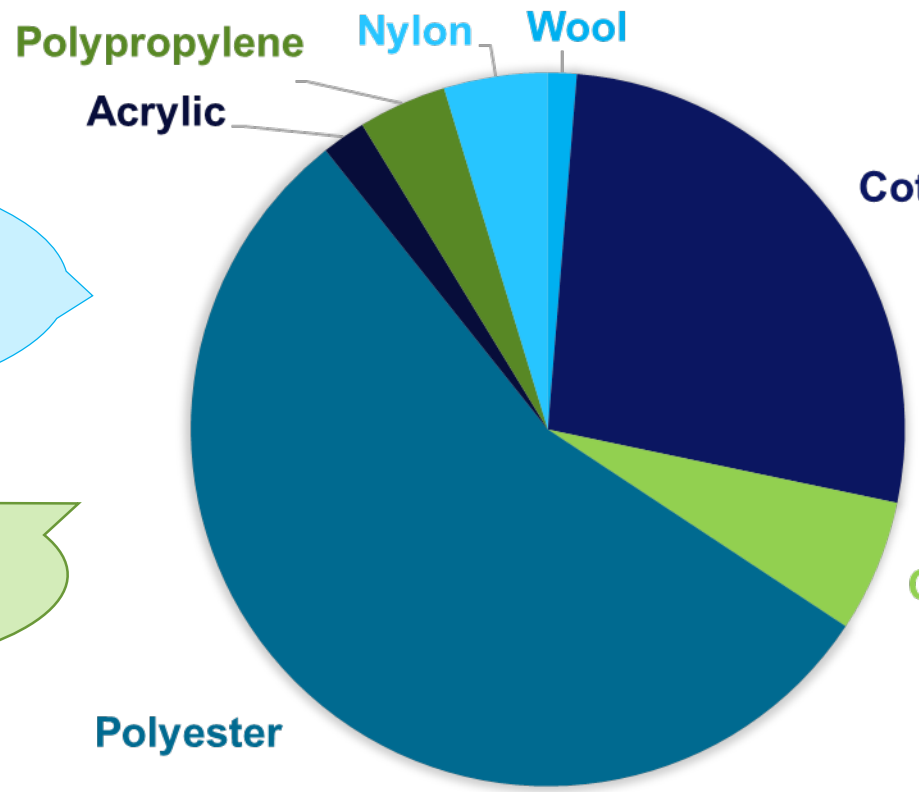
Textile Service Life



Increased Fibre Demand



Textile Raw Materials



Synthetics mainly oil-based / non-renewable materials

Biobased synthetics and recycling increasing slowly

Need for land

High irrigation water use

Fertilizers, pesticides and herbicides

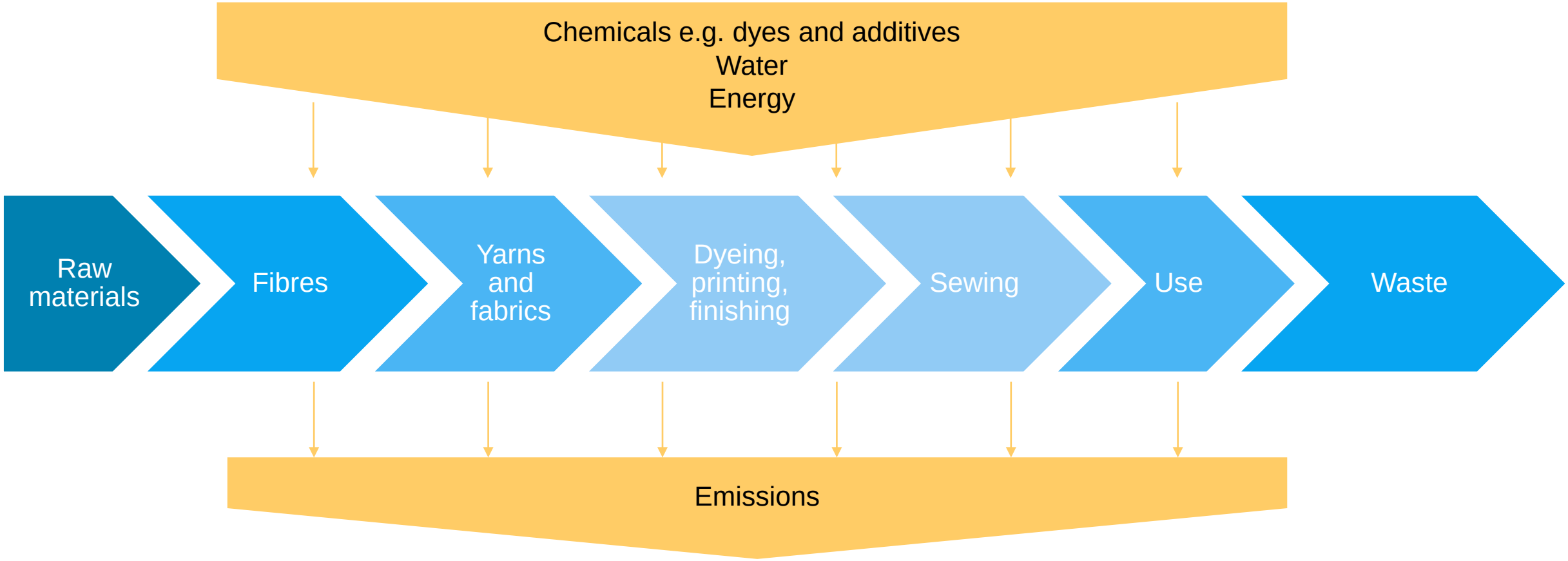
Sustainable cotton grades reduce chemical use

Alternative processes and recycled cotton raw materials

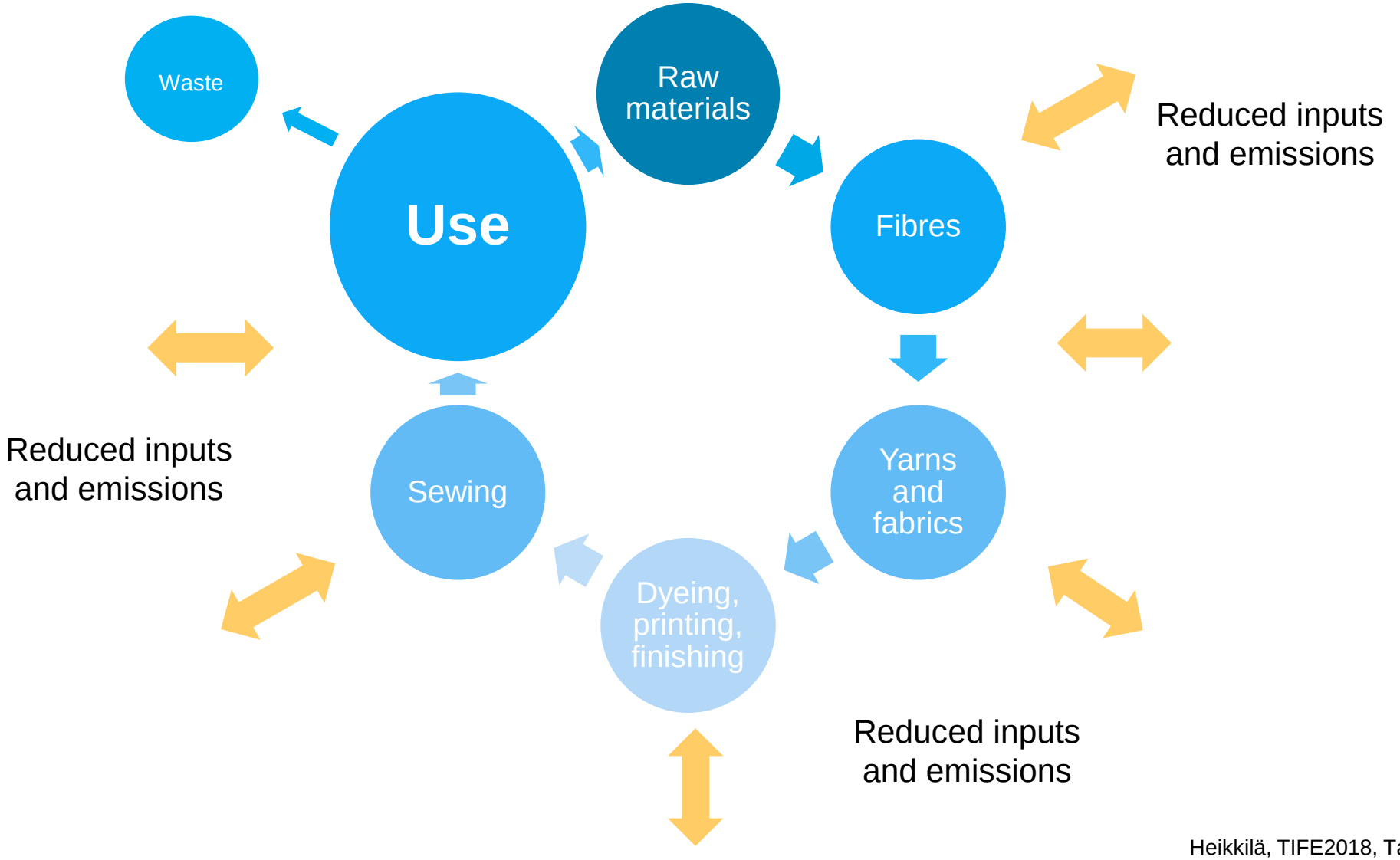
Currently mainly viscose process using CS_2

Origin of dissolving pulp(?)

Linear Model for Textiles



Circular Model for Textiles

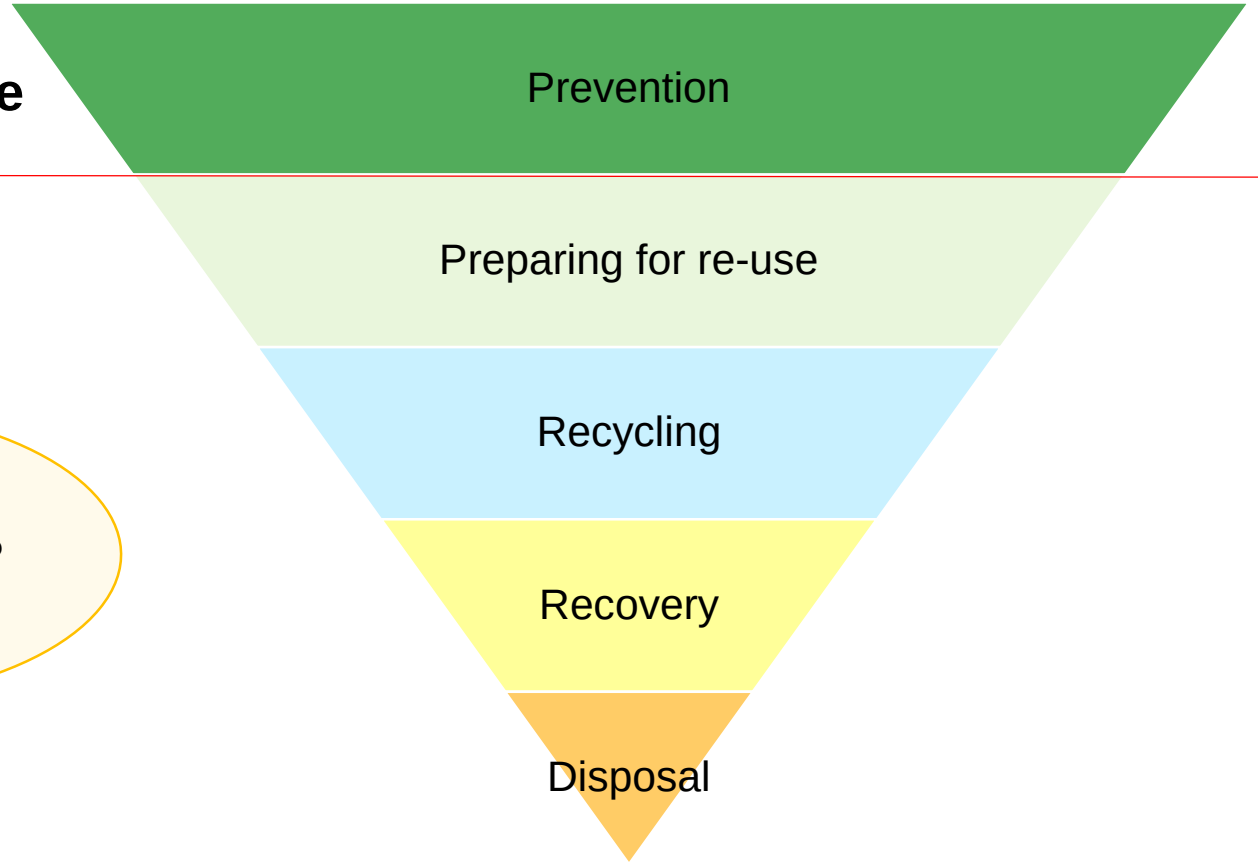


Waste Hierachy

Product = Non-waste

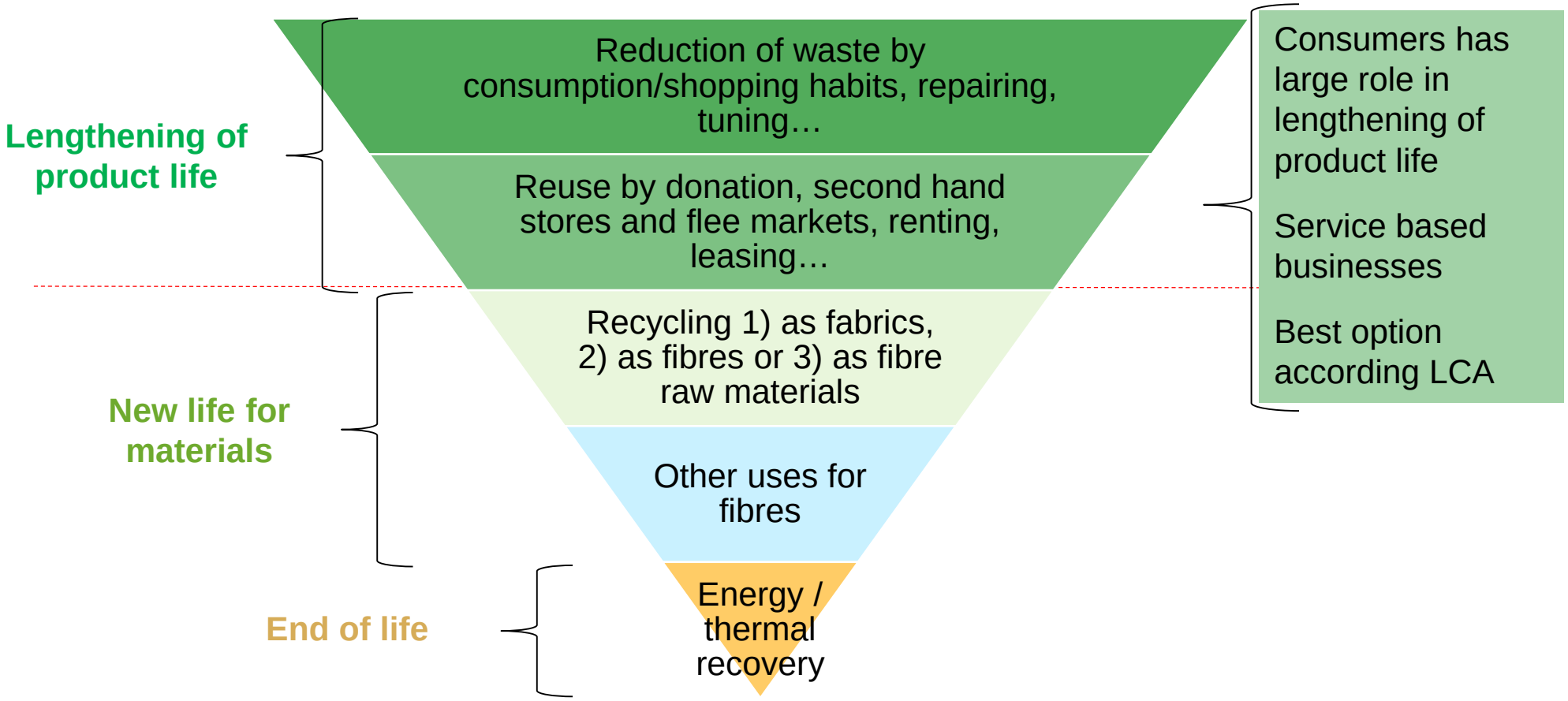
Waste

Waste regulation:
Who can process?
Export rules?

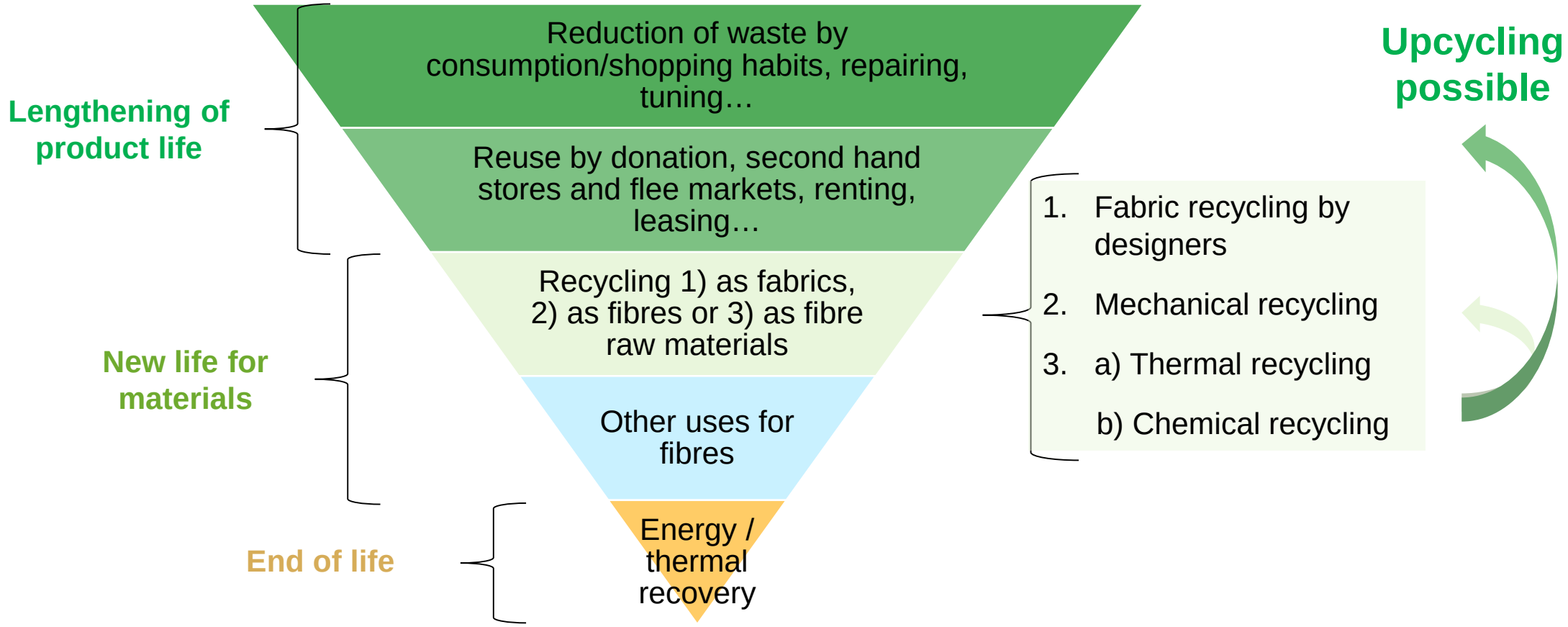


(European Commission - http://ec.europa.eu/environment/waste/framework/)

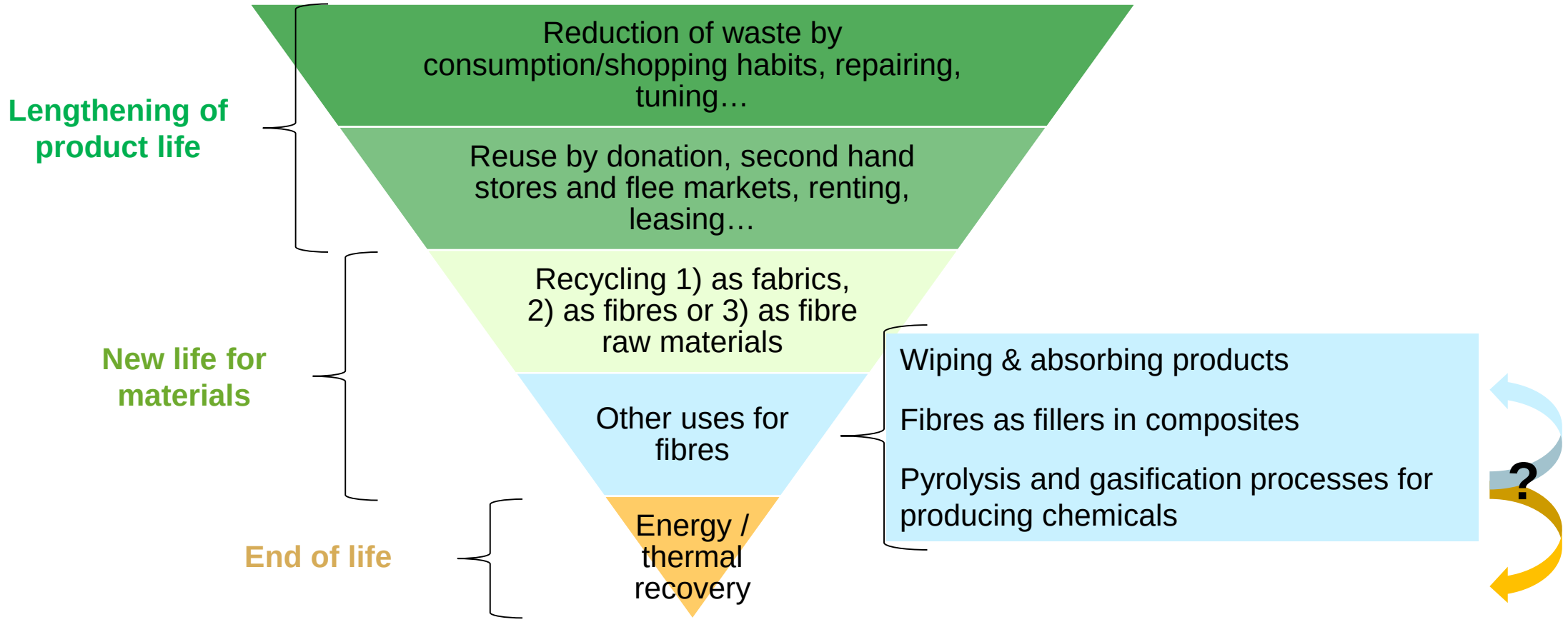
Adopted Waste Hierachy and Textiles



Adopted Waste Hierachy and Textiles

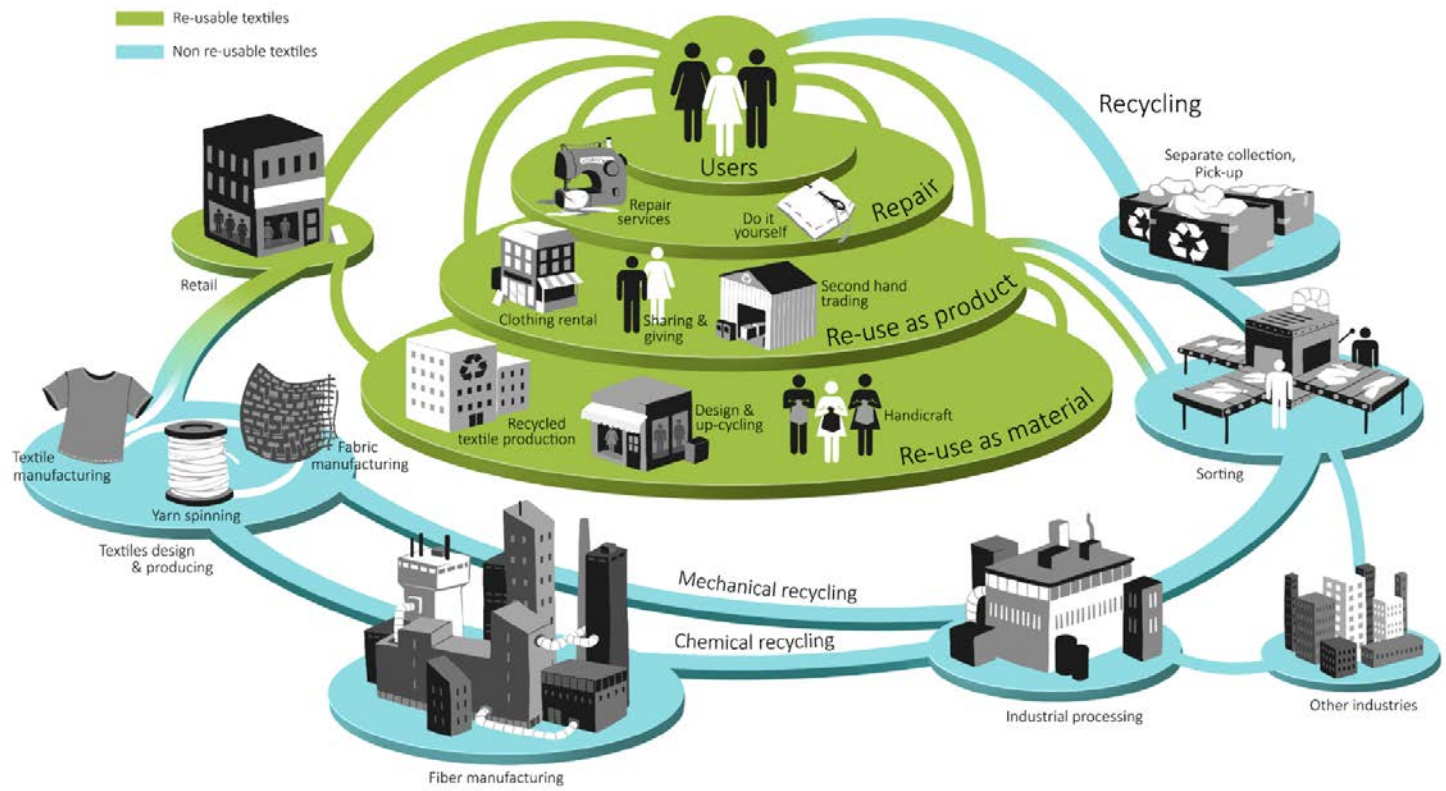


Adopted Waste Hierachy and Textiles



Model of The Circular Ecosystem of Textiles

Users have a central role in creating closed loops

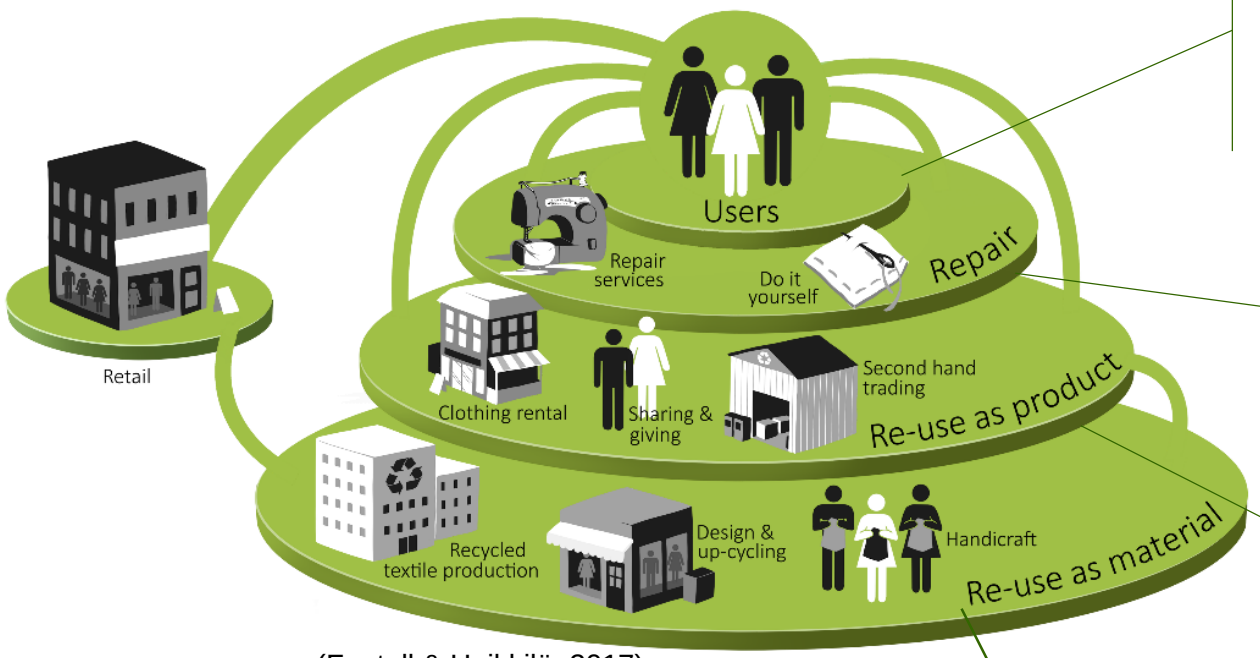


Circular economy is more than recycling

Maintain the value of products and materials as high as possible for the maximum of time with the minimum environmental impact!

(Fontell & Heikkilä, 2017 – https://www.vtt.fi/inf/pdf/technology/2017/T313.pdf)

Use, Repair and Re-Use of Textiles



(Fontell & Heikkilä, 2017)

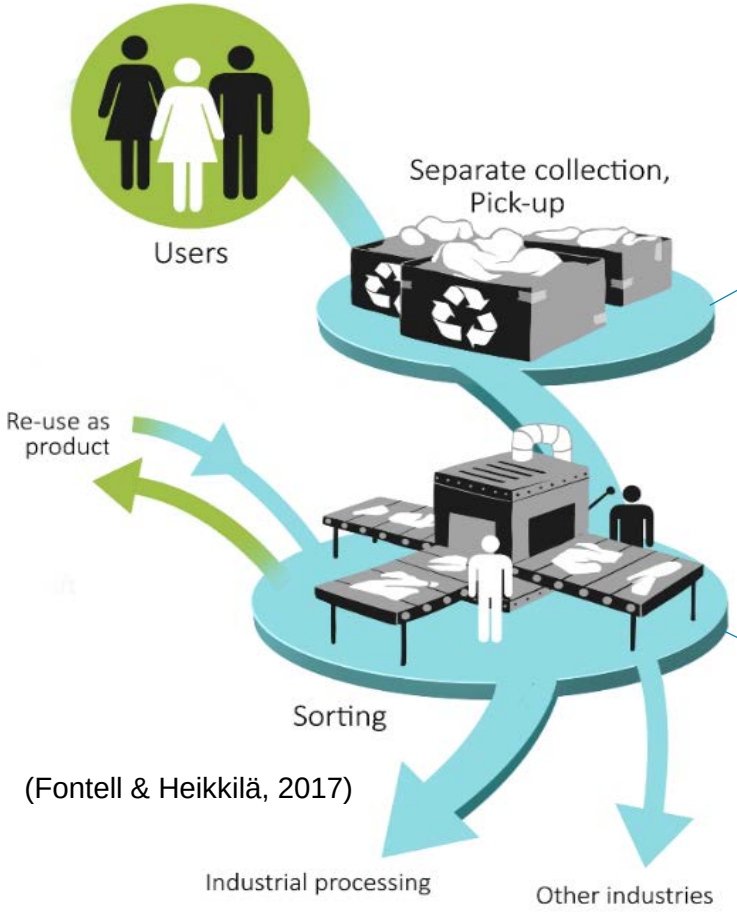
- Consumers create an demand
- Textile industry can design products that last
  - ➢ Raised consumer awareness has created markets

- Repairing
  - ➢ Big business potential - consumers may no longer have time or skills to do this

- Sharing and second-hand trading
  - ➢ New markets in e-trading and platform

- Individual consumers and small designer shops or medium size industries

Textile Collecting and Sorting



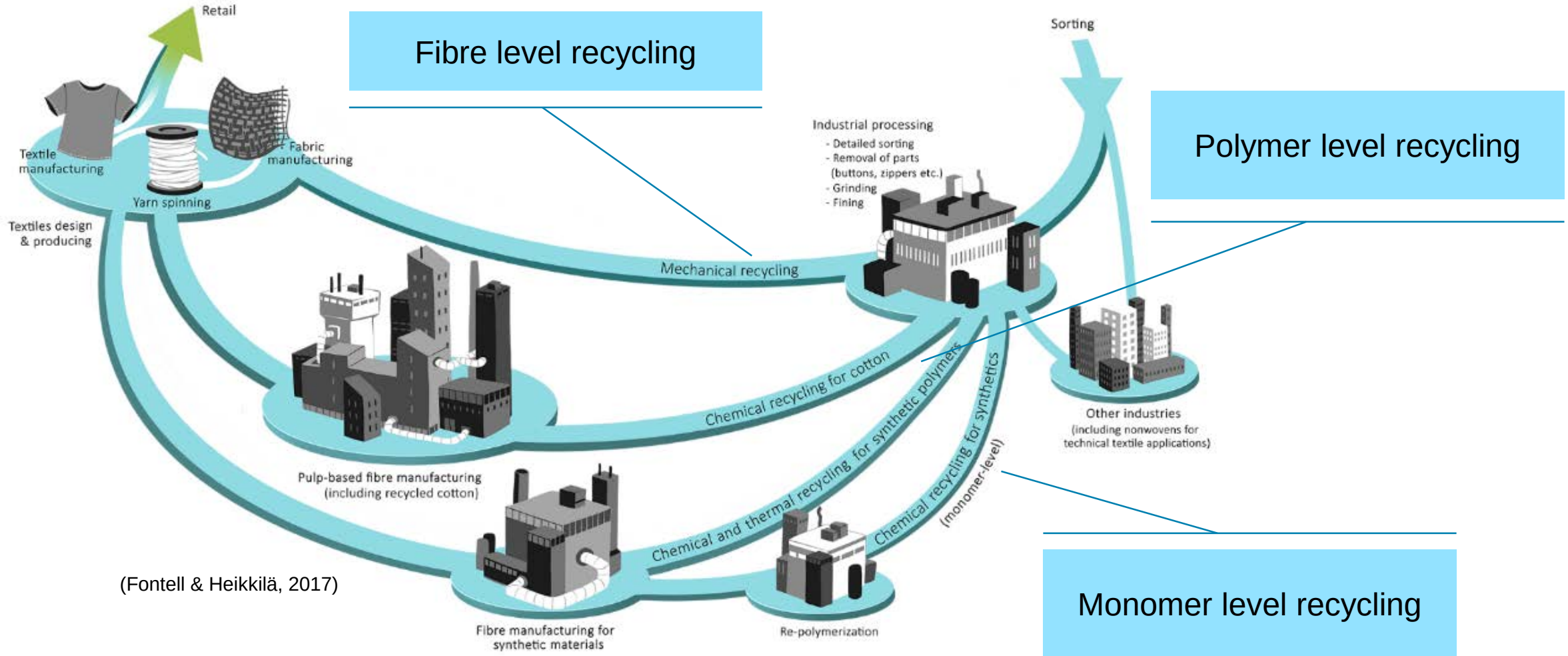
(Fontell & Heikkilä, 2017)

- When re-use and when recycle?
- Collection systems available mainly for re-usable products
- Effectively collecting without mixing with others wastes essential for industrial recycling processes

EC waste regulation: Separate collection for textiles must be set-up by 2025

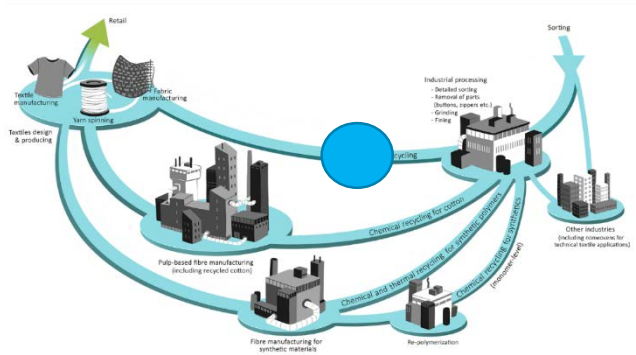
- Recycling processing options vary depending on the fibre type
- Other factors homogeneity, cleanliness and wear and tear
- Sorting needs to be taken from manual to automated process
- Traceability and identification system for textiles would be optimal solution

Textile-to-Textile Recycling



(Fontell & Heikkilä, 2017)

Fibre Level Recycling



- Mechanical recycling typically SME industry
- Typically already applied for pre-consumer textile wastes
- Colour of the fibres remain – no additional coloration needed if sorted by colour
- Length and strength of fibres determining factors for recycling process
- Materials can be to be used for making **yarns** and **nonwovens**

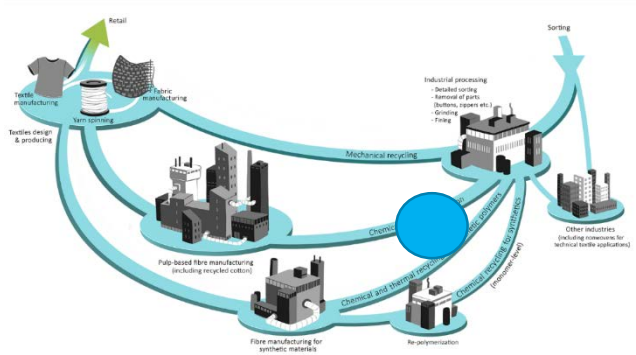
Regulation related to product safety

- Better quality with 100% fibres and blends
- Hygiene and safety important

- Blends suitable and some impurities may be acceptable, if application allows
- Hygiene might be an issue

Chemical regulation e.g. REACH in EU

Polymer Level Recycling

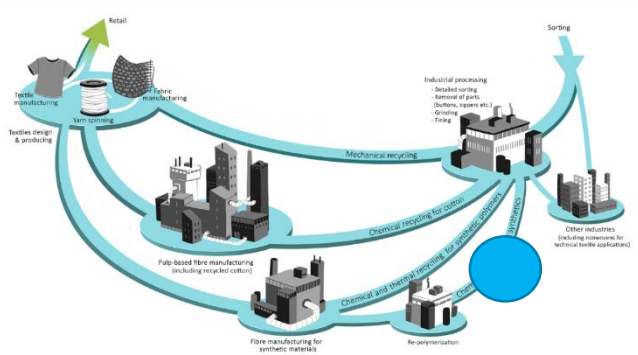


- Recycling in polymer level is can vary from small to large size industry, chemical processes in large scale
- Different process for each polymer
- **Chemical recycling by dissolution** and **thermal recycling by melting**

  - May be used to separate blends
  - Removes contaminants (hygiene not a big issue)
  - Might be affected by some contaminants (e.g. metals)
  - Currently merging & development stage for cotton
  - Technology available for acrylic fibres

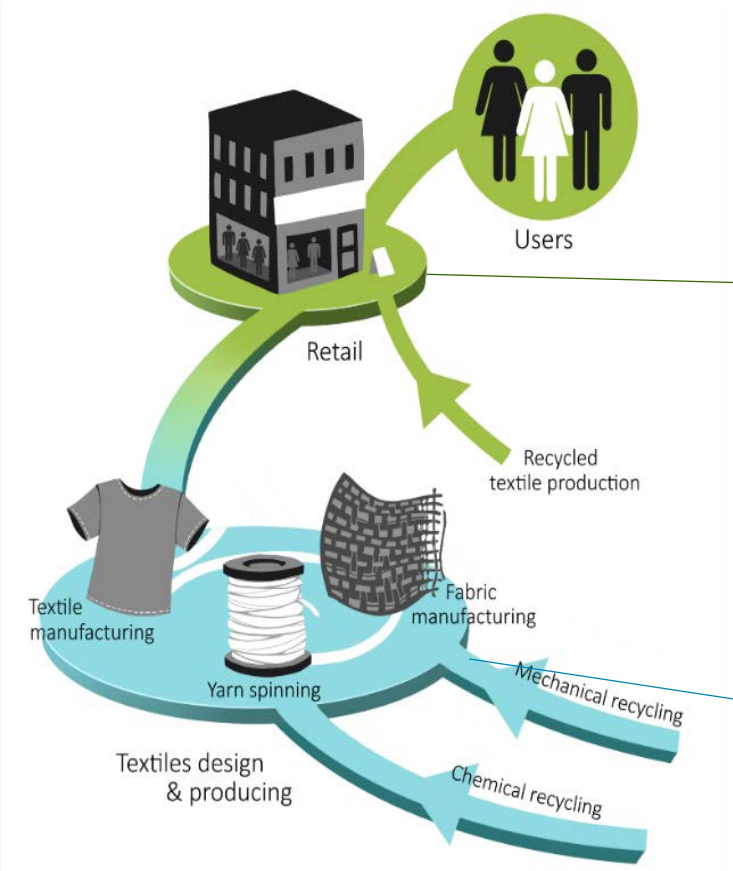
  - Polymer properties - chain length and its distribution - critical
  - Thermal processes available *and/or demonstrated* for polyester, polyamide, *polyethylene and polypropylene*

Monomer Level Recycling



- Recycling in monomer level is process industry which typically needs to be operated in large scale to be economical
- Different process for each polymer
- **Chemical recycling by re-polymerization** for synthetic fibres
  - Removes contaminants (hygiene not a big issue)
  - Might be affected by some contaminants (e.g. metals)
  - Industrial processes existing for polyester and polyamide-6 (and -66)
  - Challenge is in process economics, but process developed might change that in the future
  - Also LCA of processing needs to be considered

Textiles from Recycled Fibres



(Fontell & Heikkilä, 2017)

- Brands are interested in recycled textiles and fibres e.g. because they
  - Anticipate challenges and possible price fluctuations in the virgin materials (such as cotton) supply in the longer term, or
  - Want to offer more sustainable choices to the increasingly conscious consumers.

- Existing value chain
- The current textile technologies can handle recycled materials with some adjustments
  - Rotor spinning is more suited to shortened, recycled fibres than ring-spinning
  - Mixing post-consumer recycled fibres with virgin materials ease processing

Towards Circular Ecosystem

Textile reuse loops should/could be to be strengthened → business opportunities for forerunner companies

Brands interested in more sustainable and recycled materials, but supply still limited

Rising consumer awareness helps in creation and increase of markets

Multidisciplinary skills needed - digitalization and service based business models essential

Missing pieces of the value chain needs to be developed:

★Collecting system

★Sorting system

★Upscaling of recycling technologies

Regulation needs to be updated (waste, chemical, etc)

Public incentives and financial support could fasten transition to circular economy, **and in building of new ecosystems!**

Building Ecosystem in Finland

The Relooping Fashion Initiative

2015-2017
Tekes – The Finnish Funding Agency for Innovations

Telaketju

The collecting, sorting and recycle chain for textiles

2017-2018
Tekes
&
Ministry of Environment

2018 →
Business Finland
&
Ministry of Economic Affairs and Emploiment

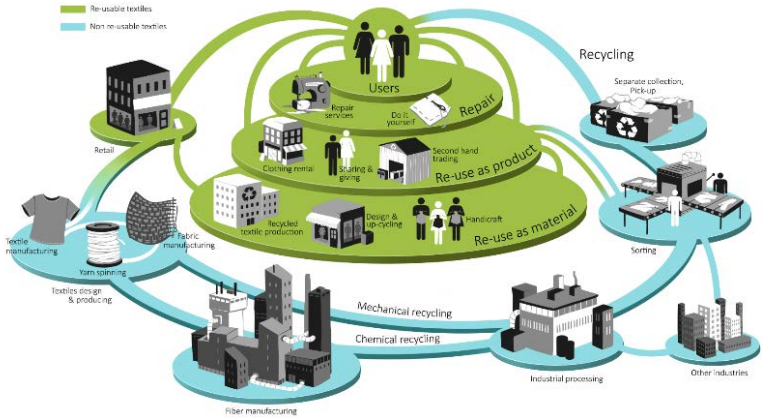
The Relooping Fashion Initiative

Piloting of closed loop recycling of cotton

Consumer studies

https://www.youtube.com/watch?v=xa-E2Re3b

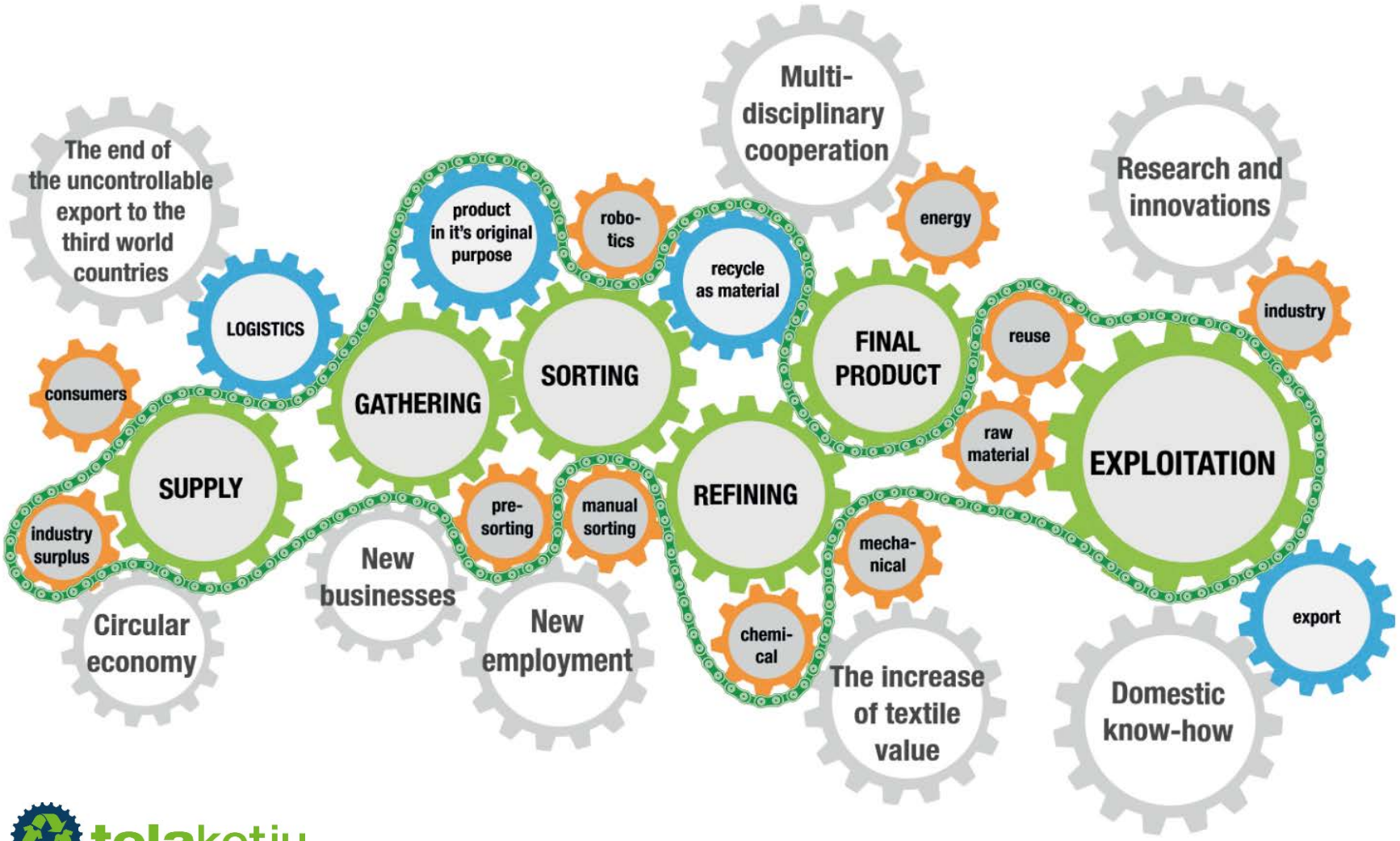
Modelling of the ecosystem



www.reloopingfashion.org

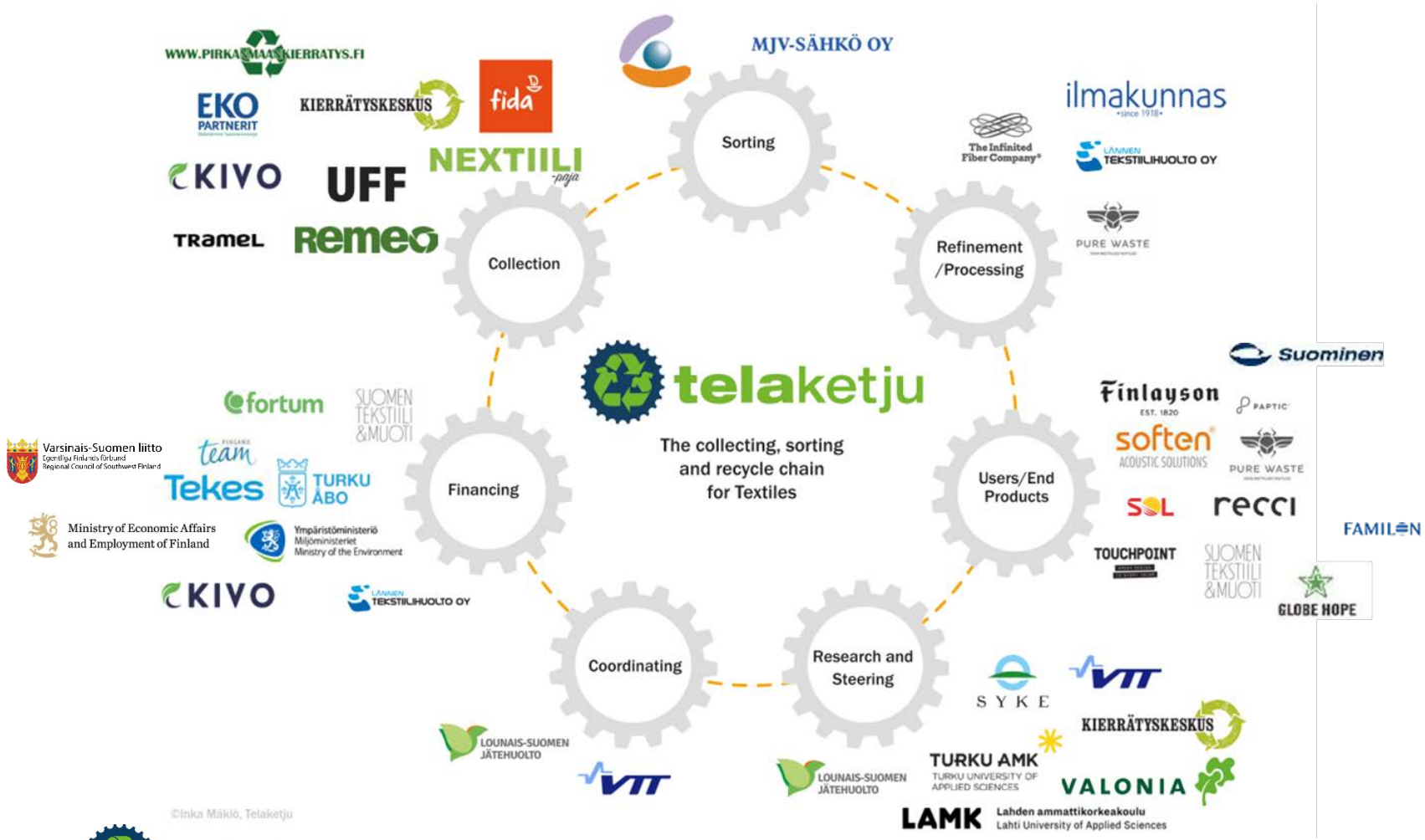
Closed Loop Recycling of Cotton

Telaketju - Ecosystem Building



www.telaketju.fi

Telaketju - Ecosystem Building



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Telaketju - Ecosystem Building

Ympäristöministeriö
Miljöministeriet
Ministry of the Environment

Topics: Collecting, sorting and pre-processing

Participants: Municipal waste management and recycling organizations, public participants, as well as charities.

Ministry of Economic Affairs and Employment of Finland

Varsinais-Suomen liitto
Egentliga Finlands förbund
Regional Council of Southwest Finland

Topics: Investments and markets & business planning

Beneficiary: Municipal waste management organization in Southwest Finland

Tekes

BUSINESS FINLAND

Topics: R&D for processes, products, services

Participants: Companies, Research Institutes, Academia

VTT

telaketju

www.telaketju.fi

Conclusions

Circular economy is coming - need for recycling, but also for lengthening product life

This changes business value chains and networks to build missing pieces of the puzzles

Change is providing new business opportunities to e.g. in services and digitalization

New technologies and innovations also needed

Consumers attitudes are starting to favour circular values

Transformation has already started – forerunners already involved

Public incentives and financial support can have significant effect on this development

Acknowledgements

Co-author in Modelling Report - Paula Fontell from Ethica

My colleagues at VTT – Ali Harlin, Eetta Saarimäki, Taina Kamppuri, Marja Pitkänen, Kaisa Vehmas, Marjo Määttänen, and many others

Project consortium on *The Relooping Fashion Initiative*

Project consortium on *Telaketju* project

Business Finland & Ministry of Environment for funding


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for your
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